JAPAN

EDICT OF GOVERNMENT

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JIS B 8620 (2002) (English): Safety code for small refrigerating equipment

安 *The citizens of a nation must honor the laws of the land.* 倂

Fukuzawa Yukichi

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JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 8620 : 2002

Safety code for small refrigerating equipment

ICS 13.110; 27.200

Reference number : JIS B 8620 : 2002 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS B 8620** : 1994 is replaced with this Standard.

Date of Establishment: 1982-09-01

Date of Revision: 2002-07-20

Date of Public Notice in Official Gazette: 2002-07-22

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Industrial Machinery

JIS B 8620:2002, First English edition published in 2003-09

Translated and published by: Japanese Standards Association
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In the event of any doubts arising as to the contents, the original JIS is to be the final authority.

Contents

Safety code for small refrigerating equipment

1 Scope This Japanese Industrial Standard specifies the construction of a part subjected to the refrigerant pressure in order to ensure the safety of refrigerant pressure on small refrigerating equipment which uses a compressor. The small refrigerating equipment refers to the refrigerating equipment of which the nominal refrigerating capacity of one refrigerant circulation system is 767 W or over to and excluding 19.3 kW and which uses the practical nonflammable and nontoxic refrigerant of which the saturation vapour pressure at the temperature of 35 °C is over 0.2 MPa up to and including 3 MPa. However, the following are to be excluded:

a) Refrigerating equipment used at the steam temperature of −60 °C or lower

b) Refrigerating equipment which uses a multiple refrigerating system

c) Air conditioners for automobiles

Remarks : The unit of refrigerant pressure refers to gauge pressure.

2 Normative references The standards given in the following contain provisions which, through reference in this Standard, constitute provisions of this Standard.

JIS B 8240 : 1986 *Construction of pressure vessels for refrigeration*

JIS B 8270 : 1993 *Pressure vessels (General standard)*

3 Definitions For the purposes of this Standard, the following definitions shall apply.

a) **refrigerating equipment** A set of equipment for refrigeration with a system which constitutes a refrigerating cycle through a compressor, condenser, receiver, evaporator, piping, etc. including the motor which drives the compressor and the controller which controls refrigerant. Heat pump equipment is included.

b) **nominal refrigerating capacity** A numeric value used as the criterion for judging the capacity of refrigerating equipment for security.

c) **refrigerant facility** A section in the refrigerating equipment through which the refrigerant passes and which is subjected to the refrigerant pressure. A lubricant system subjected to the refrigerant pressure is included.

d) **compressor** A machine which compresses the steam of refrigerant. The sections which are united with the compressor (a casing of an enclosed compressor, heat exchanger, lubricant pump, etc.) are included.

e) **pressure vessel** The following sections among refrigerant facilities shall apply:

1) A vessel (receiver, accumulator, oil separator, etc.) and a shell type heat exchanger (including a shell and tube type heat exchanger), of which the internal diameter of the trunk is over 160 mm.

2) A coil type heat exchanger composed of double tube or single tube, of which the internal diameter in the refrigerant side is over 160 mm.

3) A heat exchanger with the header exceeding 160 mm in internal diameter.

4) A vessel and a shell type heat exchanger, of which the internal diameter of the trunk is 160 mm or under and the internal volume in the refrigerant side is over 0.015 m^3.

5) A heat exchanger of lamination type, plate type and roll bond type, and others similar to this, of which the inner volume in the refrigerant side is over 0.015 m^3.

f) **piping** Pipes which connect between components among refrigerant facilities.

g) **valve** A component or device which controls the flow rate and pressure of refrigerant (for example, a stop valve, check valve, solenoid valve, expansion valve, pressure regulating valve).

h) **safety device** A high pressure cutoff device which stops the operation of the compressor by detecting pressure directly, and a pressure relief device (for example, a safety valve, fusible plug) which releases automatically the excessive pressure exceeding the predetermined pressure when the outlet pressure of compressor reaches the predetermined pressure.

i) **high pressure section** A section of the refrigerant facilities which is subjected to the condensing pressure due to the action of compressor. However, the following are excluded:

1) A section subjected to the pressure of the low pressure section in an enclosed type compressor into which a high pressure section is built.

2) An automatic expansion valve. However, for the expansion valve for heat pump, etc., the section where the secondary side of expansion valve is subjected to the pressure of high pressure section is regarded as the high pressure section.

j) **low pressure section** A section of the refrigerant facilities other than the high pressure section, including a section subjected to the intermediate pressure of two-stage compression.

k) **design pressure** A pressure used when determining the strength or thickness against the pressure of each section of the refrigerant facility in designing of refrigerating equipment, which refers to a gauge pressure as the criterion of this Standard.

l) **burning apparatus** An apparatus which burns gas, oil, etc. It contains a heating element of the surface temperature of 400 °C or higher under normal-use conditions.

m) **heat generation apparatus** A heating element of the surface temperature of lower than 400 °C under normal-use conditions, internal combustion engine, electric heater for defrosting, crankcase heater and any corresponding apparatus.

4 Nominal refrigerating capacity The calculation formula for nominal refrigerating capacity shall be as follows:

$$R = \frac{13\,900}{3.6} \cdot \frac{V}{C} \quad \cdots\cdots (1)$$

where, R : nominal refrigerating capacity (W)

V : piston displacement per hour in standard speed of revolution (m^3/h)

In the case of two-stage compressor

$$V = V_H + 0.08\,V_L$$

V_H : piston displacement per hour of the cylinder in the high stage side (m^3/h)

V_L : piston displacement per hour of the cylinder in the low stage side (m^3/h)

C : the following constant shall apply according to the classification of refrigerant.

Table 1 Value *C* by classification of refrigerant

Classification of refrigerant	C
R134a	14.4
R22	8.5
Others	$\frac{13\,900\,V_a}{0.75\,(h_a - h_b)}$

V_a : Specific volume of the dry saturated steam (the steam of a dew point for the non-azeotrope mixed gas) at the temperature of −15 °C (m^3/kg)

h_a : Specific enthalpy of the dry saturated steam (the steam of a dew point for the non-azeotrope mixed gas) at the temperature of −15 °C (kJ/kg)

h_b : Specific enthalpy of the supercooled liquid of refrigerant gas (the liquid of a boiling point of the temperature of 25 °C for the non-azeotrope mixed gas) at the condensation temperature of 30 °C, the supercooling temperature of 5 °C (kJ/kg)

5 Setting of design pressure

5.1 Set up the design pressure for every high pressure section and low pressure section of the refrigerant facility.

5.2 Let the design pressure of each component which constitutes the refrigerant facility be equal to the design pressure of the refrigerant facility assembled using each component, or be the pressure of not less than that.

5.3 Let the design pressure value of the high pressure section be not less than the highest pressure of the followings:

a) The maximum allowable working pressure of the refrigerant gas concerned to be expected in the state of usual operation.

b) The pressure of the refrigerant gas concerned produced by the highest temperature to be expected during the shut-down period.

c) The saturation pressure of the refrigerant gas concerned at the temperature of 43 °C (the liquid pressure of a boiling point of 43 °C for the non-azeotrope mixed gas).

5.4 Let the design pressure value of the low pressure section be not less than the highest pressure of the followings:

a) The maximum allowable working pressure of the refrigerant gas concerned to be expected in the state of usual operation.

b) The pressure of the refrigerant gas concerned produced by the highest temperature to be expected during the shut-down period.

c) The saturation pressure of the refrigerant gas concerned at the temperature of 38 °C (the liquid pressure of a boiling point of 38 °C for the non-azeotrope mixed gas).

6 Materials

6.1 Materials The refrigerant facility manufacturer shall confirm in consultation with the material manufacturer, etc. that the metallic materials to be used for the refrigerant facility are the materials specified in the column on material in Tables 3 to 5 of **JIS B 8240** and the materials specified in the column on material in Attached Table 2.1 and Attached Table 2.2 of **JIS B 8270** (hereafter referred to as "specified materials") or the materials having the characteristics equivalent to or better than these according to the application, and the materials confirmed as mentioned above (hereafter referred to as "confirmed materials") shall be used.

a) The specified materials shall not be used exceeding the temperature range of the allowable tensile stress value specified in Tables 3 to 5 of **JIS B 8240** and Attached Table 2.1 and Attached Table 2.2 of **JIS B 8270**. However, when the working pressure at the lowest working temperature is not more than 1/2.5 of the design pressure, it can be used within the range of the minimum allowable temperature specified in Table 6 of **JIS B 8240**.

b) It shall be made sure that the confirmed materials are used within the range in which they wear well and are suitable under the use conditions, such as pressure, temperature of the refrigerant facility.

6.2 Use limitation The metallic materials to be used for the refrigerant facility shall be as follows:

a) The materials shall not be deteriorated by refrigerant, lubricant, or any mixture of these.

b) Aluminium alloy containing more than 2 % of magnesium shall not be used.

c) Aluminium of less than 99.7 % in purity shall not be used for the part which is always in contact with water, except, however, when a suitable corrosion resistant treatment is performed.

d) Carbon steel or low alloy steel materials containing more than 0.35 % of carbon shall not be used for the weld construction.

7 Strength of each section of refrigerant facility

7.1 The strength of pressure vessel specified in **3 e)** shall be in accordance with either of the following:

a) The pressure vessel shall be designed in accordance with **JIS B 8240**, and its strength shall meet the requirements of **JIS B 8240**.

b) The strength of pressure vessel shall conform to the specification in **7.5**. In this case, the confirmation pressure shall be not less than 5 times the design pressure. However, the confirmation pressure of the pressure vessel specified in **3 e) 4)** and **5)** shall be not less than 3 times the design pressure.

7.2 The strength of compressor, refrigerant pump and valve shall conform to the specification in **7.5**. In this case, the confirmation pressure shall be not less than 3 times the design pressure. However, the confirmation pressure of the flexible section, such as a diaphragm, bellows shall be not less than 1.5 times the design pressure.

7.3 The strength of the vessel and heat exchanger other than the pressure vessel specified in **3 e)** shall be as follows:

It shall conform to the specification in **7.5**. In this case, the confirmation pressure shall be not less than 3 times the design pressure. However, for the heat exchanger tube of which the design pressure is 3.3 MPa or under, which is composed of the copper tube of 10 mm or under in diameter, of which the nominal thickness of tube is 0.4 mm or over, the procedure of **7.5** may be omitted. In this case, the section other than the heat exchanger tube shall be designed in accordance with **JIS B 8240**, and its strength shall meet the requirements of **JIS B 8240**.

7.4 The strength of piping shall be in accordance with either of the following:

a) The piping shall be designed in accordance with **4.4.9** of **JIS B 8240**, and its strength shall meet the requirements in **4.4.9** of **JIS B 8240**.

b) The strength of piping shall conform to the specification in **7.5**. In this case, the confirmation pressure shall be not less than 3 times the design pressure. However, the confirmation pressure of the flexible tube shall be not less than 1.5 times the design pressure.

7.5 Confirmation of design strength The confirmation of design strength shall be performed as follows:

a) The object under confirmation shall be manufactured in the same shape, dimensions, thickness, materials and manufacturing method as those of the object manufactured by this design.

b) After filling the object under confirmation with liquid of room temperature and removing the air completely, the confirmation pressure shall be maintained for 1 min or more by adding pressure gradually up to the confirmation pressure.

c) The breakdown or leakage of the object under confirmation shall not be allowed. However, when leakage of the gasket section and the mechanical seal section occur due to excess of the design pressure, this shall not be regarded as the leakage by the confirmation of strength. Furthermore, when the tube of 26 mm or under in external diameter which is incorporated in the inside of the trunk or tube is deformed by the external pressure of not less than 2 times the design pressure, this shall not be regarded as the breakdown by the confirmation of strength.

d) Do not use the object that was tested for practical use.

8 Safety device

8.1 High pressure cutoff device

8.1.1 Attachment of high pressure cutoff device The high pressure cutoff device shall be attached to the location where it is capable of detecting the outlet pressure of compressor of the refrigerant facility.

8.1.2 Setting of working pressure of high pressure cutoff device The setting of the working pressure of a high pressure cutoff device shall be performed as follows:

a) The high pressure cutoff device shall work under the design pressure or lower of the refrigerant facility.

b) The high pressure cutoff device shall work under the working pressure or lower of the pressure relief device.

8.1.3 Actuation of high pressure cutoff device For the high pressure cutoff device, a hand reset type shall be used. However, when it has a structure such that the pressure does not rise above the design pressure even if the operation and stop are automatically performed, the automatic reset type may be used.

8.1.4 Omission of high pressure cutoff device The attachment of high pressure cutoff device may be omitted according to the criterion of the following **a**) or **b**).

a) When the discharge tube of two or more compressors is common, the high pressure cutoff device can be shared.

b) For air cooling type refrigerating equipment of 9 kg or under in the amount of refrigerant contained, the attachment of a high pressure cutoff device may be omitted in the case where the pressure of not more than 1.5 times the design pressure can be maintained when the air cooling type refrigerating equipment is operated at the rated voltage and rated frequency (60 Hz for common use of 50/60 Hz) of the power source under the conditions of standard cooling (cooling, refrigeration) temperature, and the blower for the condenser is forced to stop. In this case, the attachment of high pressure cutoff device may be omitted also in the case where the pressure of not more than 1.5 times the design pressure can be maintained according to either of conditions of the following **1**) and **2**).

1) When the protective device relevant to temperature, current, overload relay, etc. works

2) When the compressor has a built-in safety valve

8.2 Pressure relief device

8.2.1 Attachment of pressure relief device The attachment of pressure relief device shall be performed as follows:

a) The safety valve shall be attached to the shell type condenser and the receiver among the pressure vessels of the high pressure section of refrigerant facility. However, for the shell type condenser and the receiver of 0.5 m^3 in internal volume, the fusible plug may be replaced.

b) When connecting to the shell type condenser and the receiver, either of the pressure relief devices may be omitted according to the criterion of the following **1)** and **2)**.

1) The mutual connecting pipe shall not have a stop valve, and shall have a larger bore diameter than that of the pressure relief device which is intended to be omitted.

2) The bore diameter of the remaining pressure relief device shall be the bore diameter or under determined according to the formula specified in **8.2.3 b)**.

c) At least one or more pressure relief devices shall be attached to the high pressure section of the refrigerant facility which does not have the shell type condenser or the receiver to be used as the pressure vessel. However, for the air cooling type refrigerating equipment of 4.5 kg or under in the amount of contained refrigerant, the pressure relief device can be omitted.

8.2.2 Setting of the working pressure of the pressure relief device The setting of the working pressure of the pressure relief device shall be performed as follows:

a) The set pressure of the safety valve shall be the design pressure or lower of the refrigerant facility to which the safety valve is attached, and the working pressure shall be such that the valve opens at the set pressure or higher, and starts to blow at not more than 1.15 times the set pressure.

b) The melting temperature of the fusible plug shall be 75 °C or lower, or shall be the saturation temperature or lower of the refrigerant being used which corresponds to 1.5 times the design pressure of refrigerant facility.

8.2.3 Bore diameter of the pressure relief device attached to shell type condenser and receiver The bore diameter of the pressure relief device attached to shell type condenser and receiver shall be as follows:

a) The bore diameter of safety valve shall not be less than the value determined according to the following formula.

$$d_3 = C_3\sqrt{D \cdot L} \quad \cdots\cdots (2)$$

where, d_3 : minimum bore diameter of safety valve (mm)

D : external diameter of shell type condenser or receiver (m)

L : length of shell type condenser or receiver (m)

C_3 : constant described in the following table or value determined according to the following formula

Table 2 Constant C_3 by classification of refrigerant

Classification of refrigerant	Value of C_3	
	High pressure section	Low pressure section
R134a	7.9	9.4
R22	8.0	11.0

(formula for C_3)

The value of C_3 for the high pressure section and low pressure section of other refrigerant gases shall be obtained according to the following formula, respectively.

$$C_3 = 359\sqrt{\frac{1}{P \cdot r \cdot \sqrt{M}}} \quad \cdots\cdots (3)$$

where, P : allowable pressure (MPa)

r : latent heat of evaporation under the allowable pressure of refrigerant gas (kJ/kg)

M : molecular weight (in the case where the gas mixed with two or more kinds of gases is the refrigerant gas, the molecular weight shall be the sum of the value obtained by multiplying the molar fraction of the gas concerned by the molecular weight of the gas concerned for every component gas)

Remarks : The bore diameter of the common safety valve in the case where two or more vessels are connected is calculated by substituting the sum value of $D \cdot L$ of each vessel for the value of $D \cdot L$ of the formula described above.

b) The bore diameter of the fusible plug shall be not less than half the bore diameter calculated in **a**).

8.2.4 Bore diameter of the pressure relief device attached to the refrigerant facility without a shell type condenser or receiver The bore diameter of the pressure relief device attached to the refrigerant facility without the shell type condenser or receiver shall be as follows:

a) The bore diameter of safety valve shall be 5 mm or over.

b) The bore diameter of fusible plug shall be 2.5 mm or over when the amount of contained refrigerant exceeds 4.5 kg, 1.5 mm or over when it is 4.5 kg or under.

9 Burning apparatus and heat generation apparatus:

For refrigerating equipment with the refrigerant facility and burning apparatus or heat generation apparatus put together, when the burning apparatus is made to be in the maximum burning condition, or when the heat generation apparatus is made to be in the maximum heat generation condition, the equilibrium pressure in the refrigerant facility shall not exceed the design pressure of the refrigerant facility even if the refrigerant facility is subjected to the effect of heat.

In order to maintain equilibrium pressure in the refrigerant facility under its design pressure, the amount of heat generation of burning apparatus or heat generation apparatus shall be chosen, or (the burning apparatus or the heat generation apparatus) shall be stopped so that the equilibrium pressure does not exceed the design pressure.

10 Withstand pressure, air leakage efficiency of each section of refrigerant facility Each section of refrigerant facility shall have a withstand pressure, and air leakage efficiency required by carrying out the test in **11** according to the division specified in Table 3.

Table 3 Pressure test of each section of refrigerant facility

Pressure test / Division of each section of refrigerant facility	Withstand pressure test or strength test	Airtight test
a) Pressure vessel	○	○
b) Compressor, refrigerant pump	○	○
c) Vessel, heat exchanger	—	○
d) Piping, valve	—	○
e) Refrigerant facility with assembling completed	—	○

Remarks 1 The airtight test of each component is not always needed when the airtight test of the refrigerant facility of which the assembly is completed can also serve as the airtight test of each component.

2 The test record shall be retained for seven years.

11 Pressure test

11.1 Withstand pressure test The withstand pressure test shall be performed for a single assembly or all components of the product concerned.

a) The test pressure shall be not less than 1.5 times the design pressure of the product concerned.

b) For the test, after filling the object under test with a liquid of room temperature and removing the air completely, the pressure shall be gradually increased up to the test pressure, and the test pressure shall be maintained for 1 min or longer.

c) It shall be confirmed that the object under test has no breakdown, leakage, or abnormal deformation. However, when a small amount of leakage of the gasket section and the mechanical seal section occurs in such a degree that their withstand pressure performance is not damaged in excess of the design pressure, this shall not be regarded as leakage.

d) When performing the withstand pressure test with gases, air or inert gases shall be used, and the test shall be carried out after taking protective measures so that it is carried out safely.

In addition, in this case, the object under test which passed the withstand pressure test with gases shall be regarded as passing the airtight test.

11.2 Strength test When uniform articles are able to be manufactured owing to the appropriate quality control of the manufacturer, the strength test may be performed with a sample taken at random according to the following conditions:

a) The object under test shall be sampled from the articles produced with the same shape, dimensions, thickness, materials, and manufacturing methods as those of the articles manufactured in the same lot at the same manufacturing plant. The alteration of the product unrelated to the strength or the existence of accessories which have no affect on the strength shall be regarded as a product of the same lot.

b) The inspection shall be performed by selecting either of the two sampling methods; one method is such that one or more pieces in three months are sampled as an inspection lot, and the other is such that one or more pieces per numerical quantity specified below are sampled as an inspection lot.

For the product specified in **7.1** 1 000 pieces

For the product specified in **7.2** 3 000 pieces

c) The test pressure shall be not less than 3 times the design pressure.

d) After filling the object under test with a liquid of room temperature and removing the air completely, the pressure shall be gradually increased up to the test pressure, and the test pressure shall be maintained for 1 min or longer. The test shall be carried out after taking the protective measures so that it is carried out safely.

e) The breakdown or leakage of the object under test shall not be allowed. However, when leakage of the gasket section or the mechanical seal section occurs due to an excess of the design pressure, this shall not be regarded as leakage in the strength test. Furthermore, when the tube of 26 mm or under in external diameter which is incorporated in the inside of trunk or tube is deformed by the external pressure of not less than 2 times the design pressure, this shall not be regarded as the breakdown in the strength test.

f) The product in the lot which passed the strength test can have the withstand pressure test omitted.

g) Do not use the object that was tested for practical use.

11.3 Airtight test The airtight test shall be performed for a single assembly of the product or all refrigerant facilities which has completed assembling.

a) The test pressure shall be the design pressure or higher of the product.

b) For the test, the pressure of air or inert gases shall be gradually applied to the object under test. After maintaining the test pressure, when it is put in water or the outside is coated with a bubble solution, no bubble shall be generated. Or, the absence of leakage shall be confirmed with a gas leak detector.

c) When the individual airtight test of the compressor, pressure vessel, coil type heat exchanger, etc. associated with facilities concerned with the refrigerant facilities of 20 mm or under in nominal piping connection diameter is performed and passed, the airtight test of the piping section and connecting section shall be performed with the outside coated with a bubble solution under the saturation pressure or higher of the refrigerant concerned at the temperature of 20 °C, and no bubbles shall be generated, or the absence of leakage shall be confirmed with a gas leak detector.

12 Marking

12.1 The punch mark, name plate, etc. on which the items specified in the following are marked shall be attached to a legible location on the refrigerating equipment.

a) Manufacturer's name or abbreviation

b) Serial number or year and month of manufacture

c) Name and amount of refrigerant to be filled

d) Design pressure(1) [high pressure section(2), low pressure section(3)]

Notes (1) The design pressure may be marked as D.P.

(2) The high pressure section may be marked as H.

(3) The low pressure section may be marked as L.

12.2 The punch mark, name plate, etc. on which the items specified in the following are marked shall be attached to a legible location on the compressor. However, the items which are not required to be especially marked as agreed between the refrigerating equipment manufacturer and the compressor manufacturer may be omitted.

a) Manufacturer's name or abbreviation

b) Serial number or year and month of manufacture

c) Name of refrigerant

d) Design pressure(1) [high pressure section(2), low pressure section(3)]

12.3 The punch mark, name plate, etc. on which the items specified in the following are marked shall be attached to a legible location on the pressure vessel. However, the items which are not required to be especially marked as agreed between the refrigerating equipment manufacturer and the pressure vessel manufacturer may be omitted.

a) Manufacturer's name or abbreviation

b) Serial number or year and month of manufacture

c) Name of refrigerant

d) Design pressure(1)

12.4 The punch mark, name plate, etc. on which the items specified in the following are marked shall be attached to the high pressure cutoff device.

a) Manufacturer's name or abbreviation

b) Serial number or year and month of manufacture

c) Working pressure

12.5 The punch mark, name plate, etc. on which the items specified in the following are marked shall be attached to the safety valve.

a) Manufacturer's name or abbreviation

b) Serial number or year and month of manufacture

c) Set pressure

Errata for JIS (English edition) are printed in *Standardization Journal*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

Errata will be provided upon request, please contact:

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